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By JAMES R. RIEGEL

PATENT

Attorney Docket No.: IMM1P060.RE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re reissue application of:	
Craig F. Culver	Examiner: Unassigned
Serial No.: Unassigned	Art Unit: Unassigned
Filed: Unassigned	**REISSUE DECLARATION UNDER 37 C.F.R. § 1.175(a) AND POWER OF ATTORNEY BY INVENTORS**
For: INTERFACE CONTROL	

The Honorable Commissioner of Patents and Trademarks
Washington, D. C. 20231

Sir:

I, Craig F. Culver, state and declare the following:

1. I am a citizen of the United States of America residing at 201 Ware Road, Woodside, CA 94062.

2. The entire right, title and interest to U.S. Patent No. 5,666,138, issued September 9, 1997 is vested in Immersion Corp., a California corporation having a regular and established place of business at 2158 Paragon Dr., San Jose, CA 95131, except for an exclusive license back to Craig F. Culver for all products outside the force feedback field of use.

3. I verily believe myself to be the original, first, and sole inventor of the invention described and claimed in the above-identified United States Letters Patent and in the present application for reissue of the above-identified United States Letters Patent.

4. I have reviewed and understand the contents of the attached specification and claims, including the new claims as presented in this application for reissue of the original Letters Patent.

5. I acknowledge the duty to disclose information of which I am aware and which is material to the examination of this application for reissue of the original Letters Patent in accordance with 37 C.F.R. § 1.56, including information which was discovered between the filing date of United States Patent Application Serial No. 08/343,300 that matured into the Letters Patent for which reissue is being sought and the filing date of this application for reissue.

6. I verily believe that the original Letters Patent is partly or wholly inoperative or invalid by reason of my claiming more or less than I had a right to claim in the original Letters Patent, and that the errors described below which render said Letters Patent so partly or wholly inoperative or invalid occurred through inadvertence and/or omission without any fraudulent or deceptive intent on my part.

7. More specifically, I believe that the original Letters Patent for which I seek reissue claims more or less than I had the right to claim for the following reasons:

7.1. Column 4, lines 31-33, 45-47, 52-55, and 58-61 and several other columns of the original Letters Patent include what I believe to be an accurate and proper characterization of a force feedback device including several features, reproduced below:

> First sensor 26 ... is coupled to arm member 20 and senses the angular rotation of arm member 20 about point 22...Thumbpiece 28... is slidably mounted within cavity 30 of arm member 20 and may slide along the length of arm member 20... Curved contact surface 38, which is provided on a top surface of thumbpiece 28, engages the thumb of a user operating hand-held interface control 10 (FIGS. 2, 3A, and 3B)... Second sensor 42, which is disposed within arm member 20, detects the linear movement of shaft 40 (and thus the linear movement of thumbpiece 28) relative to sensor 42...When a user exerts a downward pressure upon thumbpiece 28, third sensor 44

engages base plate 14 and in response thereto generates a trigger control signal...

A user cradles hand-held interface control 10 in the palm of his or her hand, positioning his fingers along the underside of bottom plate 14 and resting his thumb on curved contact surface 38 of thumbpiece 28, as shown in FIG. 5. Using only his thumb, the user may control the horizontal and vertical positioning of, for instance, a cursor on a display screen, as well as implement various related functions (such as seleting options from a pull-down menu)...

The downward pressure exerted by the thumb to implement a trigger control signal is always orthogonal to the thumb motions used to control horizontal and vertical positioning, regardless of the angular position of arm member 20 or the linear position of thumbpiece 28... Indeed, interface controls 10 and 50 are suitable for one-handed operation, thereby leaving the user's other hand free to perform other tasks...

Interface controls 10 and 50 are ideal for replacing the mouse or trackball in computer software applications such as word processing, databases, and spreadsheets. For instance, interface control 50 of FIG. 6... is well suited for use with video games. As described above, thumbpiece 28 may be used to control the positioning of a character in the video game...

Embodiments of the present invention may also be incorporated into conventional two-handed video game controllers (see FIG. 1) to provide a superior video game interface control. For example, positioning control keys 2a, 2b, 2c, and 2d (FIG. 1) may be replaced by interface control 10...

Various forms of feedback may be added to the above described embodiments to provide a user with additional information about the particular application he or she is controlling, as described

below in reference to FIGS. 11 and 12. For instance, arm member 20 of interface control 10 ... may be fitted with a first actuator that in response to a first feedback signal prevents arm member 20 from further pivoting in one or both directions or, in the alternative, alters the frictional contact between arm member 20 and base plate 14 so as to alter the ease with which arm member 20 pivots...

Arm member 20 of interface control 80 has coupled thereto electromagnetic coil 82 which, in turn, is wound around a conventional ferrous core (not shown)...In other words, coil 82, shaft 84, and armature 88 act as a magnetically activated brake. Varying levels of feedback current will result in proportionally varying levels of drag. This brake may be implemented to simulate detents, stops, or other forms of reflective feedback.

In a similar manner, a second actuator may be provided that in response to a second feedback signal inhibits the movement of thumbpiece 28 along arm member 20... The embodiments described above...would, for instance, be especially well suited for use with applications in which it is desirable to preclude a user from selecting certain options or moving a cursor into certain areas... Thus, the feedback signals, by restraining or even preventing (1) arm member 20 from pivoting about point 22 and/or (2) thumbpiece 28 from sliding along arm member 20 directly inform the user he can no longer move in that direction. In a similar manner, an additional actuator may be contained within third sensor 44 (see FIG. 3A) to preclude activation of trigger functions at certain predetermined character positions...

In other applications, interface control 80 (FIG. 11) may be used to facilitate the selection of options or icons. As the user moves the cursor or pointer over an icon displayed on a screen, feedback signals generated by the application may simulate a detent by increasing the frictional coupling between arm member 20 and sidewall 16b and between thumbpiece 28 and arm member 20, as

described above with reference to FIGS. 11 and 12, when the cursor or pointer is positioned near or overlaps certain icons displayed on the screen. This simulated detent varies the amount of force the user must exert to effect further positioning changes in certain directions, i.e., the detent may either make it easier or harder for the user to cause the cursor to pass across the icon. In this manner, the user can "feel" when he or she has reached a particular icon (or any other specific screen location). This simulated detent may be deactivated when, for instance, the icon has been selected or when the cursor has passed over the icon.

The actuators discussed above may comprise a solenoid, a servomotor, or any other suitable device known in the art which generates a force in response to electric signals. The actuators may also employ shape-memory alloys, piezo ceramics, or electro-rheological compounds. Further, motor-type actuators may be employed to augment or restrain motion.

In other embodiments, the actuators discussed above may used to activate and deactivate electrically controlled detents so as to provide tactile click stops in the pivoting motion of arm member 20 (FIG. 2) about point 22 or in the linear motion of thumbpiece 28 along arm member 20. These detents may be logically correlated with specific targets or options on a display screen such that once a particular option is selected, its corresponding detent is electrically deactivated...

7.2. The absence in the original Letters Patent of an independent claim in which a handheld force feedback device for providing positioning signals to a computer for positioning a displayed cursor, where the device includes a housing able to be held by the hand of a user, a user manipulatable member moveable by the user's thumb in two dimensions, at least one sensor for sensing movement of the user manipulatable member, at least one actuator for providing force in at least one of the dimensions of the user manipulatable member to facilitate the selection of displayed

options or icons based on feedback signals from an application, and a trigger sensor for detecting a trigger command from the user which includes moving the member approximately orthogonally to the two dimensions, without the recital of specific elements such as a rotatable arm member and slidable contact member, such as is provided in new claim 24 below, resulted in the original Letters Patent claiming less than the applicant had a right to claim. At the time of drafting and prosecution of the application that matured into the original Letters Patent, I did not perceive that such a claim could be made. I recently reviewed the claims of the original Letters Patent and realized that there was an issue that I may have claimed less than I had a right to claim, and I have been consulting with my counsel to determine whether a reissue should be filed to cure this error.

7.3. To cure the aforementioned error of inadvertent omission, I therefore request the addition of a claim such as claim 24 below:

> 24. A handheld force feedback device coupled to a computer for providing positioning signals to said computer for positioning a cursor displayed on a display device, said device comprising:
>
> a support housing able to be held by a hand of a user;
>
> a user manipulatable member engageable and moveable by a thumb of said user in two dimensions relative to said support housing while said support housing is held by said hand of said user, wherein said movement in said two dimensions positions said cursor in two screen dimensions on said display device;
>
> at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two dimensions, said sensor providing positioning signals which control said positioning of said cursor on said display device;
>
> at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in at least one of said dimensions of said user manipulatable member, wherein said force facilitates the selection of options or icons displayed on said display device based on feedback signals generated by an application running on said computer; and

a trigger sensor for detecting a trigger command from said user, said trigger command including moving said user manipulatable member approximately orthogonally to said two dimensions.

7.4. The addition of such a claim would cure my error of inadvertent omission by reciting a hand-held force feedback device that includes a user manipulatable member moveable in two dimensions, a sensor, at least one actuator for outputting a force facilitating object selection, and a trigger sensor, without the inclusion of elements which are not required to distinguish the invention over the prior art. In particular, this claim differs from the independent claims of the present Letters Patent by reciting, among other elements, a user manipulatable member moveable in two dimensions relative to a handheld housing, a sensor for sensing motion in at least one of those dimensions, at least one actuator for outputting a force in at least one of those dimensions for facilitating selection of displayed options or icons, and a trigger sensor for detecting a trigger command that moves the user manipulatable member approximately orthogonally to the two dimensions, without the inclusion of other elements such as a rotatable arm member and slidable contact member, which are now understood not to be required to distinguish the invention recited in claim 24.

7.5. New dependent claims 25 and 26 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 where the two dimensions are provided substantially in a single plane, and where the motion of the user manipulatable member is orthogonal to a plane defined by the planar dimensions.

7.6. New dependent claim 27 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 and which recites that two actuators are provided to provide force in the two dimensions.

7.7. New dependent claims 28 and 29 would cure the inadvertent omission of claims which recite the force feedback device of claim 24 and which recite that the user manipulatable member is coupled to an arm member having rotary motion about a pivot point and the actuator is coupled to the arm member to output forces about the pivot point, and that the arm member is limited to an arcuate path of less than ninety degrees.

7.8. New dependent claims 30 and 31 would cure the inadvertent omission of claims which recite the force feedback device of claim 28 and which recites that the first actuator is grounded to the housing and the second actuator is carried by the arm member, and where the user manipulatable member is a sliding contact member which can be moved in a linear dimension approximately perpendicular to an axis of rotation of the arm member and in substantially the same plane as the rotary motion.

7.9. New dependent claim 32 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 and which recites that the cursor can be positioned and displayed icons or options can be selected by a single hand of the user.

7.10. New dependent claim 33 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 and which recites that the actuator is one of a motor, a brake, and a solenoid.

7.11. New dependent claims 34 and 35 would cure the inadvertent omission of claims which recite the force feedback device of claim 24 and which recite that the user manipulatable member is coupled to a centering spring return that causes a bias on the user manipulatable member to return to a center position after it has been moved from the center position, and where a centering spring bias on said user manipulatable member may be electrically actuated by a signal received from the computer, allowing the force feedback device to have a centering mode and a non-centering mode, selected by the computer.

7.12. New dependent claims 36, 37, and 38 would cure the inadvertent omission of claims which recite the force feedback device of claim 24 and which recite that the cursor can be used to select an icon, the trigger command selects the icon when the cursor is positioned over the icon, that the actuator outputs a force to augment or restrain motion of the cursor on the screen, and that the image is a video game character.

7.13. New dependent claim 39 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 and a trigger actuator for causing

resistance to the motion of the trigger command by the user based on a feedback signal from the computer.

7.14. New dependent claim 40 would cure the inadvertent omission of a claim which recites the force feedback device of claim 24 and at least one additional control provided on the housing and operable by a different hand of the user.

7.15. New dependent claims 41, 42, and 43 would cure the inadvertent omission of claims which recite the force feedback device of claim 24 and which recite that the actuator outputs detents when the cursor overlaps or is positioned near an icon displayed on the screen, that the detents provide tactile click stops correlated with targets or options displayed on the screen, and that a detent correlated with a target or option is deactivated once the target or option is selected by the user using the force feedback device.

7.16. New dependent claims 44 and 45 would cure the inadvertent omission of claims which recite the force feedback device of claim 41 and which recite that the user selects the target or option by causing a trigger signal to be sent to the computer, the trigger signal caused by a pressing motion of the user manipulatable member, and that the detents are output for use in a word processor or spreadsheet program provided on the computer.

7.17. I further believe that the absence in said Letters Patent of an independent claim in which a force feedback device for providing positioning signals to a computer for manipulating a displayed image, where the device includes a housing, a user manipulatable member moveable by the user's digit in two degrees of freedom, at least one sensor for sensing movement of the user manipulatable member in the two degrees of freedom, at least one computer controlled brake for providing drag in at least one of the degrees of freedom, and a trigger sensor for detecting a trigger command from the user which includes a pressing motion by the user's digit causing the member to move in a different degree of freedom, without the recital of specific elements such as a rotatable arm member and slidable contact member, such as is provided in new 46 below, is an error of inadvertent omission that occurred during the drafting and prosecution of the application that matured into the present Letters

Patent. At the time of drafting and prosecution of the application that matured into the present Letters Patent, I did not perceive that a device that includes the above elements should be claimed independently, without the inclusion of other elements such as are included in claims 1-23 of the present Letters Patent. To cure the aforementioned error of inadvertent omission, I therefore request the addition of a claim such as claim 46 below:

> 46. A force feedback device coupled to a computer for providing positioning signals to said computer for manipulating an image displayed on a screen by said computer, said device comprising:
>
> a support housing;
>
> a user manipulatable member coupled to said housing and engageable and moveable by one or more digits of said user in two degrees of freedom relative to said housing, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;
>
> at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said sensor providing positioning signals which control positioning of said image on said screen by said computer;
>
> at least one computer controlled brake coupled to said user manipulatable member, wherein said brake provides a drag in at least one of said degrees of freedom of said user manipulatable member; and
>
> a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion by said digit causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

7.18. New dependent claim 47 would cure the inadvertent omission of a claim which recites the force feedback device of claim 46and which recites that the housing is able to be held and operated by a single hand of a user.

7.19. New dependent claims 48 and 49 would cure the inadvertent omission of claims which recite the force feedback device of claim 46 and which recite that the

other of the two degrees of freedom is a linear degree of freedom, and that the two degrees of freedom are approximately in the same plane.

7.20. New dependent claim 50 would cure the inadvertent omission of a claim which recites the force feedback device of claim 46 and which recites that the brake is a first brake providing a drag in a first of the two degrees of freedom, and further comprising a second computer controlled brake coupled to said user manipulatable member, where the second brake provides a drag in a second one of the degrees of freedom.

7.21. New dependent claims 51 and 52 would cure the inadvertent omission of claims which recite the force feedback device of claim 50 and which recite that the user manipulatable member is coupled to an arm member having rotary motion about a pivot point, where the first brake is coupled to the arm member to output forces about the pivot point, and that the user manipulatable member is a sliding member which can be moved along at least a portion of the arm member in a linear degree of freedom, where the second brake outputs forces in the linear degree of freedom.

7.22. New dependent claims 53 and 54 would cure the inadvertent omission of claims which recite the force feedback device of claim 46 and which recite that the cursor can be used to select an icon displayed on the screen, where the trigger command selects the icon when the cursor is positioned over the icon, and that the brake outputs a force controlled by the computer to provide tactile clicks correlated with targets or options displayed on the screen.

7.23. New dependent claim 55 would cure the inadvertent omission of a claim which recites the force feedback device of claim 46 and which recites that the device is provided in an automobile dashboard or automobile steering wheel.

7.24. New dependent claims 56 and 57 would cure the inadvertent omission of claims which recite the force feedback device of claim 46 and which recite that the brake includes an electromagnetic coil, and that the brake employs an eletro-rheological compound.

7.25. New dependent claims 48 and 49 would cure the inadvertent omission of claims which recite the force feedback device of claim 46 and which recite that the handle is capable of moving in only two degrees of freedom, and that the two degrees of freedom are linear degrees of freedom.

7.26. I further believe that the absence in said Letters Patent of an independent claim reciting a method for providing positioning signals from a user to a computer to manipulate a displayed cursor, including providing a handheld force feedback device including a thumb member moveable by a user in two degrees of freedom, sensing movement of the thumb member to provide positioning signals, and providing a drag in the two degrees of freedom using at least one braking actuator to facilitate selection of a displayed icon or option, claimed without the inclusion of other elements included in claims 1-24 of the original patent, such as is provided in new claim 58 below, is an error of inadvertent omission that occurred during the drafting and prosecution of the application that matured into the present Letters Patent. At the time of drafting and prosecution of the application that matured into the present Letters Patent, I did not perceive that a method that includes the above elements should be claimed independently, without the inclusion of other elements such as are included in claims 1-23 of the present Letters Patent. To cure the aforementioned error of inadvertent omission, I therefore request the addition of a claim such as claim 58 below:

58. A method for providing positioning signals to a computer from a user for manipulating a displayed cursor on a screen and for providing force feedback to said user, said method comprising:

providing a handheld force feedback device coupled to said computer, said handheld force feedback device including a thumb member engageable and moveable by a thumb of said user in two degrees of freedom while said device is held by said hand of said user;

sensing movement of said thumb member in said two degrees of freedom using at least one motion sensor and providing positioning signals to said computer in accordance with said sensed movement, wherein said positioning signals are used by said host computer to move a cursor displayed on a screen in two dimensions of said screen; and

providing a drag in said two degrees of freedom of said thumb member using at least one braking actuator coupled to said thumb member, wherein said drag facilitates selection of an icon or option displayed on said screen by said cursor.

7.27. New dependent claim 59 would cure the inadvertent omission of a claim which recites the method of claim 58 and which recites detecting a trigger command from said user including a pressing motion of the thumb member, where the trigger command is sent to the computer to be used to select an option or icon displayed on the screen with the cursor.

7.28. New dependent claims 60 and 61 would cure the inadvertent omission of claims which recite the method of claim 58 and which recites that the two degrees of freedom are substantially in a single plane, and that one of the degrees of freedom is a rotary degree of freedom and another of the degrees of freedom is a linear degree of freedom.

7.29. New dependent claim 62 would cure the inadvertent omission of a claim which recites the method of claim 58 and which recites that the brakes output drag to hinder motion of a rotating member coupled to the thumb member and hinder a sliding motion of the thumb member.

7.30. Column 11, lines 42-48 and 55-61 of the original Letters Patent include what I believe to be an accurate and proper characterization of a force feedback device including a spring mechanism, reproduced below:

> Embodiments of the present invention may also be equipped with a spring return mechanism. With reference to interface control 10 (FIG. 2), a centering spring may be coupled to arm member 20 which causes arm member 20 to return to its center position whenever arm member 20 has deviated from the center position by exerting pressure on arm member 20...The centering spring may also be electrically actuated by an external signal from the interfaced device (i.e., computer, video game, and so on). Inclusion of such an electrically

actuated spring allows the interfaced device to switch the controller between two modes of operation (spring centering and non-centering), as the particular application may require.

7.31. I further believe that the absence in said Letters Patent of an independent claim reciting a handheld force feedback device for providing positioning signals to a computer for positioning a displayed cursor, including a housing, a user manipulatable member moveable by a digit of a user in two degrees of freedom, where one of the degrees of freedom is rotary, a spring return mechanism to provide a centering bias on the member toward a center position of the rotary degree of freedom, at least one sensor for providing positioning signals, at least one actuator for providing a force in one of said degrees of freedom, and a trigger sensor for detecting a trigger command from the user, including a pressing motion in a different degree of freedom, claimed without the inclusion of other elements included in claims 1-24 of the original patent, such as is provided in new claim 63 below, is an error of inadvertent omission that occurred during the drafting and prosecution of the application that matured into the present Letters Patent. At the time of drafting and prosecution of the application that matured into the present Letters Patent, I did not perceive that a device that includes the above elements should be claimed independently, without the inclusion of other elements such as are included in claims 1-23 of the present Letters Patent. To cure the aforementioned error of inadvertent omission, I therefore request the addition of a claim such as claim 63 below:

63. A handheld force feedback device coupled to a computer for providing positioning signals to said computer for positioning a cursor displayed on a screen, said device comprising:

a support housing;

a user manipulatable member coupled to said housing and engageable and moveable by a digit of said user in two degrees of freedom relative to said housing while said housing is held by said hand of said user, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

a spring return mechanism coupled to said user manipulatable member to provide a centering bias on said user manipulatable member toward a center position of said rotary degree of freedom when said user manipulatable member has been moved from said center position;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said sensor providing positioning signals which control said positioning of said cursor on said screen;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in one of said degrees of freedom of said user manipulatable member; and

a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

7.32. New dependent claim 64 would cure the inadvertent omission of a claim which recites the force feedback device of claim 63 and which recites that the spring return mechanism is electrically actuated by an external signal received from the computer, allowing the spring return mechanism to be selectively applied in a centering mode and allowing the spring return mechanism to have no effect in a non-centering mode.

7.33. New dependent claim 65 would cure the inadvertent omission of a claim which recites the force feedback device of claim 64 and which recites that the external signal is controlled by a video game running on the computer.

7.34. New dependent claim 66 would cure the inadvertent omission of a claim which recites the force feedback device of claim 64 and which recites that the spring return mechanism is coupled to a pivotable arm member providing the rotary degree of freedom, and further comprising a centering spring coupled to the user manipulatable member to provide a centering bias in another of the two degrees of freedom.

7.35. Column 9, lines 6-15 of the original Letters Patent include what I believe to be an accurate and proper characterization of a force feedback device for use in an automobile, reproduced below:

> The above described interface controls may be mounted in virtually any enclosure, including (but not limited to) control panels, automobile dashboards, steering wheels, or handgrips of other interface controls. For instance, in one such embodiment, base plate 14 (FIG. 2) may be disposed within the handgrip portion of a floor-mounted lever arm control, i.e., a transmission selector in a vehicle, to provide users with a superior means to control such things as the vehicle's navigation system or communications with the vehicle's on-board computer system.

7.36. I further believe that the absence in said Letters Patent of an independent claim in which a force feedback control provided in an automobile and coupled to an on-board vehicle computer system for providing input to the computer system, including a user manipulatable member, sensor, actuator, and trigger sensor, claimed without the inclusion of other elements included in claims 1-23 of the original patent, such as is provided in new claim 67 below, is an error of inadvertent omission that occurred during the drafting and prosecution of the application that matured into the present Letters Patent. At the time of drafting and prosecution of the application that matured into the present Letters Patent, I did not perceive that a device that includes the above elements should be claimed independently, without the inclusion of other elements such as are included in claims 1-23 of the present Letters Patent. To cure the aforementioned error of inadvertent omission, I therefore request the addition of a claim such as claim 67 below:

> 67. A force feedback control provided in an automobile and coupled to an on-board vehicle computer system for providing input to said computer system, said control comprising:
>
> a user manipulatable member provided in an automobile dashboard, said member engageable and moveable by a digit of said user in two degrees

of freedom relative to said dashboard, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said input to said computer system based on positioning signals provided by said sensor;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in one of said degrees of freedom of said user manipulatable member; and

a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

7.37. New dependent claim 68 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the user manipulatable member is manipulated by the user to provide communication with the on-board computer system.

7.38. New dependent claim 69 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the input to the computer system controls a vehicular navigation system.

7.39. New dependent claim 70 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the two degrees of freedom of the user manipulatable member define a plane.

7.40. New dependent claim 71 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the trigger degree of freedom is orthogonal to the plane.

7.41. New dependent claim 72 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the actuator is a motor.

7.42. New dependent claim 73 would cure the inadvertent omission of a claim which recites the force feedback device of claim 67 and which recites that the actuator is a passive brake.

7.43. I hereby appoint the following attorneys and agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

James R. Riegel, Reg. No. 36,651; Paul L. Hickman, Reg. No. 28,516; L. Keith Stevens, Reg. No. 32,632; Brian R. Coleman, Reg. No. 39,145; Michael E. Melton, Reg. No. 32,276; Jerry Wei, Reg. No. 43,247; Robert D. Hayden, Reg. No. 42,645; Kevin J. Zilka (Reg. No. 41,429); and Dominic M. Kotab, Reg. No. 42,762.

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9. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of sole inventor: Craig F. Culver

Inventor's signature: Craig F. Culver.

Date: 9/7/99.

Country of Citizenship: USA
Residence: 201 Ware Road
Woodside, CA 94062
Post Office Address: Same.

NEW CLAIMS

24. A handheld force feedback device coupled to a computer for providing positioning signals to said computer for positioning a cursor displayed on a display device, said device comprising:

a support housing able to be held by a hand of a user;

a user manipulatable member engageable and moveable by a thumb of said user in two dimensions relative to said support housing while said support housing is held by said hand of said user, wherein said movement in said two dimensions positions said cursor in two screen dimensions on said display device;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two dimensions, said sensor providing positioning signals which control said positioning of said cursor on said display device;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in at least one of said dimensions of said user manipulatable member, wherein said force facilitates the selection of options or icons displayed on said display device based on feedback signals generated by an application running on said computer; and

a trigger sensor for detecting a trigger command from said user, said trigger command including moving said user manipulatable member approximately orthogonally to said two dimensions.

25. A force feedback device as recited in claim 24 wherein said two dimensions are provided substantially in a single plane.

26. A force feedback device as recited in claim 25 wherein said motion of said user manipulatable member is orthogonal to a plane defined by said planar dimensions.

27. A force feedback device as recited in claim 24 wherein said at least one actuator is a first actuator, and further comprising a second actuator coupled to said

user manipulatable member, wherein said second actuator provides a force in the other of said dimensions of said user manipulatable member.

28. A force feedback device as recited in claim 24 wherein said user manipulatable member is coupled to an arm member having rotary motion about a pivot point to provide motion in one of said two dimensions, wherein said actuator is coupled to said arm member to output forces about said pivot point.

29. A force feedback device as recited in claim 28 wherein said rotary motion of said arm member is limited to an arcuate path of less than ninety degrees.

30. A force feedback control device as recited in claim 28 further comprising a second actuator, and wherein said first actuator is grounded to said housing and wherein said second actuator is carried by said arm member.

31. A force feedback device as recited in claim 28 wherein said user manipulatable member is a sliding contact member which can be moved in a linear dimension approximately perpendicular to an axis of rotation of said arm member and in substantially the same plane as said rotary motion, thereby providing said motion in one of said two dimensions.

32. A force feedback device as recited in claim 24 wherein said cursor can be positioned and displayed icons or options can be selected by a single hand of said user.

33. A force feedback device as recited in claim 24 wherein said at least one actuator is one of a motor, a brake, and a solenoid.

34. A force feedback device as recited in claim 24 wherein said user manipulatable member is coupled to a centering spring return that causes a bias on said user manipulatable member to return to a center position after it has been moved from said center position.

35. A force feedback device as recited in claim 24 wherein a centering spring bias on said user manipulatable member may be electrically actuated by a signal received from said computer, allowing said force feedback device to have a centering mode and a non-centering mode, selected by said computer.

36. A force feedback device as recited in claim 24 wherein said cursor can be used to select an icon, wherein said trigger command selects said icon when said cursor is positioned over said icon.

37. A force feedback device as recited in claim 36 wherein said at least one actuator outputs a force to augment or restrain motion of said cursor on said screen.

38. A force feedback device as recited in claim 24 wherein said image is a video game character.

39. A force feedback device as recited in claim 24 further comprising a trigger actuator for causing resistance to said motion of said trigger command by said user based on a feedback signal from said computer.

40. A force feedback device as recited in claim 24 further comprising at least one additional control provided on said housing and operable by said user, wherein said additional control is operated by a different hand of said user than said hand operating said user manipulatable member.

41. A method as recited in claim 24 wherein said at least one actuator outputs detents when said cursor overlaps or is positioned near an icon displayed on said screen.

42. A method as recited in claim 41 wherein detents provide tactile click stops correlated with targets or options displayed on said screen.

43. A method as recited in claim 42 wherein a detent correlated with a target or option is deactivated once said target or option is selected by said user using said force feedback device.

44. A method as recited in claim 41 wherein said user selects said target or option by causing a trigger signal to be sent to said computer, said trigger signal caused by a pressing motion of said user manipulatable member.

45. A method as recited in claim 41 wherein said detents are output for use in a word processor or spreadsheet program provided on said computer.

46. A force feedback device coupled to a computer for providing positioning signals to said computer for manipulating an image displayed on a screen by said computer, said device comprising:

a support housing;

a user manipulatable member coupled to said housing and engageable and moveable by one or more digits of said user in two degrees of freedom relative to said

housing, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said sensor providing positioning signals which control positioning of said image on said screen by said computer;

at least one computer controlled brake coupled to said user manipulatable member, wherein said brake provides a drag in at least one of said degrees of freedom of said user manipulatable member; and

a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion by said digit causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

47. A force feedback device as recited in claim 46 wherein said housing is able to be held and operated by a single hand of a user.

48. A force feedback device as recited in claim 46 wherein the other of said two degrees of freedom is a linear degree of freedom and wherein said rotary degree of freedom allows a pivoting motion of said digit of said user.

49. A force feedback device as recited in claim 47 wherein said two degrees of freedom are approximately in the same plane.

50. A force feedback device as recited in claim 46 wherein said at least one brake is a first brake providing a drag in a first of said two degrees of freedom, and further comprising a second computer controlled brake coupled to said user manipulatable member, wherein said second brake provides a drag in a second one of said degrees of freedom of said user manipulatable member.

51. A force feedback device as recited in claim 50 wherein said user manipulatable member is coupled to an arm member having rotary motion about a pivot point, wherein said first brake is coupled to said arm member to output forces about said pivot point.

52. A force feedback device as recited in claim 51 wherein said user manipulatable member is a sliding member which can be moved along at least a portion of said arm member in a linear degree of freedom, and wherein said second brake outputs forces in said linear degree of freedom.

53. A force feedback device as recited in claim 46 wherein said cursor can be used to select an icon displayed on said screen, wherein said trigger command selects said icon when said cursor is positioned over said icon.

54. A force feedback device as recited in claim 46 wherein said brake outputs a force controlled by said computer to provide tactile clicks correlated with targets or options displayed on said screen.

55. A force feedback device as recited in claim 46 wherein said device is provided in an automobile dashboard or automobile steering wheel.

56. A force feedback device as recited in claim 46 wherein said at least one brake includes an electromagnetic coil.

57. A force feedback device as recited in claim 46 wherein said at least one brake employs an electro-rheological compound.

58. A method for providing positioning signals to a computer from a user for manipulating a displayed cursor on a screen and for providing force feedback to said user, said method comprising:

providing a handheld force feedback device coupled to said computer, said handheld force feedback device including a thumb member engageable and moveable by a thumb of said user in two degrees of freedom while said device is held by said hand of said user;

sensing movement of said thumb member in said two degrees of freedom using at least one motion sensor and providing positioning signals to said computer in accordance with said sensed movement, wherein said positioning signals are used by said host computer to move a cursor displayed on a screen in two dimensions of said screen; and

providing a drag in said two degrees of freedom of said thumb member using at least one braking actuator coupled to said thumb member, wherein said drag facilitates selection of an icon or option displayed on said screen by said cursor.

59. A method as recited in claim 58 further comprising detecting a trigger command from said user, said trigger command including a pressing motion of said thumb member, wherein said trigger command is sent to said computer to be used to select an option or icon displayed on said screen with said cursor.

60. A method as recited in claim 58 wherein said two degrees of freedom are substantially in a single plane.

61. A method as recited in claim 58 wherein one of said degrees of freedom is a rotary degree of freedom and another of said degrees of freedom is a linear degree of freedom.

62. A method as recited in claim 58 wherein said brakes output drag to hinder motion of a rotating member coupled to said thumb member and hinder a sliding motion of said thumb member.

63. A handheld force feedback device coupled to a computer for providing positioning signals to said computer for positioning a cursor displayed on a screen, said device comprising:

a support housing;

a user manipulatable member coupled to said housing and engageable and moveable by a digit of said user in two degrees of freedom relative to said housing while said housing is held by said hand of said user, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

a spring return mechanism coupled to said user manipulatable member to provide a centering bias on said user manipulatable member toward a center position of said rotary degree of freedom when said user manipulatable member has been moved from said center position;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said

sensor providing positioning signals which control said positioning of said cursor on said screen;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in one of said degrees of freedom of said user manipulatable member; and

a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

64. A force feedback device as recited in claim 63 wherein said spring return mechanism is electrically actuated by an external signal received from said computer, allowing said spring return mechanism to be selectively applied in a centering mode and allowing said spring return mechanism to have no effect in a non-centering mode.

65. A force feedback device as recited in claim 64 wherein said external signal is controlled by a video game running on said computer.

66. A force feedback device as recited in claim 64 wherein said spring return mechanism is coupled to a pivotable arm member providing said rotary degree of freedom, and further comprising a centering spring coupled to said user manipulatable member to provide a centering bias in another of said two degrees of freedom.

67. A force feedback control provided in an automobile and coupled to an on-board vehicle computer system for providing input to said computer system, said control comprising:

a user manipulatable member provided in an automobile dashboard, said member engageable and moveable by a digit of said user in two degrees of freedom relative to said dashboard, wherein at least one of said degrees of freedom is a rotary degree of freedom about an axis of rotation;

at least one sensor coupled to said user manipulatable member and sensing movement of said user manipulatable member in said two degrees of freedom, said input to said computer system based on positioning signals provided by said sensor;

at least one actuator coupled to said user manipulatable member, wherein said actuator provides a force in one of said degrees of freedom of said user manipulatable member; and

a trigger sensor for detecting a trigger command from said user, said trigger command including a pressing motion causing said user manipulatable member to move in a trigger degree of freedom different from said two degrees of freedom.

68. A force feedback control as recited in claim 67 wherein said user manipulatable member is manipulated by said user to provide communication with said on-board computer system.

69. A force feedback control as recited in claim 67 wherein said input to said computer system controls a vehicular navigation system.

70. A force feedback control as recited in claim 67 wherein said two degrees of freedom of said user manipulatable member define a plane.

71. A force feedback control as recited in claim 67 wherein said trigger degree of freedom is orthogonal to said plane.

72. A force feedback control as recited in claim 67 wherein said actuator is a motor.

73. A force feedback control as recited in claim 67 wherein said actuator is a passive brake.